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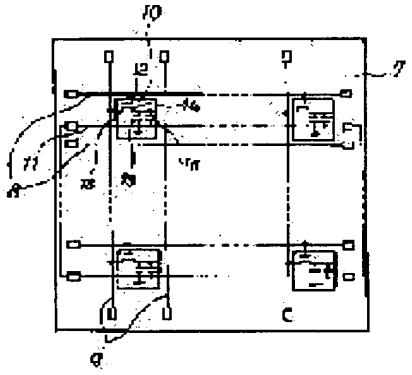
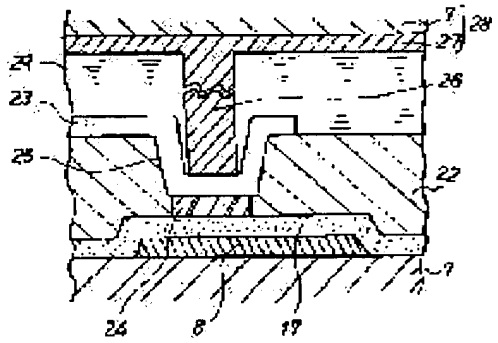
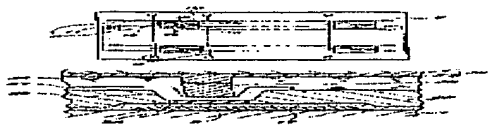
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a liquid crystal device permitting to have a stable auxiliary capacity value, obtain a uniform gap between substrates by arranging cylindrical spacers and achieve a good display.
SOLUTION: In an auxiliary capacity part of a TFT array substrate in this liquid crystal display device, an electrode 24 for an auxiliary capacity formed in a same layer as data wiring 9 is arranged via a gate







insulation film 17 on address wiring 8, and an auxiliary capacity 16 is formed from this electrode 24 for the auxiliary capacity and the lower layer of the address wiring 8. Further, in a contact hole 25 provided in such an auxiliary capacity part 16, a cylindrical spacer 26 formed from laminated layers of colored layers on the opposing substrate side is accommodated for an arrangement and keeps a fixed gap between the substrates.

LEGAL STATUS

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The pixel electrode which address wiring of two or more, data wiring, and a switching element were formed on the insulating substrate, respectively, and was prepared in the upper layer of the switching element of a parenthesis through the insulating layer, In the liquid crystal display equipped with the liquid crystal layer pinched between the 1st substrate which has the auxiliary part by volume electrically connected with this pixel electrode, respectively, the 2nd substrate with which the counterelectrode was formed on the insulating substrate, and said 1st substrate and 2nd substrate While forming said auxiliary part by volume with auxiliary capacity wiring by which opposite arrangement was carried out through said data wiring, the electrode for auxiliary capacity formed in this layer, this electrode for auxiliary capacity, and the insulator layer The liquid crystal display characterized by carrying out hold arrangement of the pillar-shaped spacer for maintaining a gap with said 2nd substrate in the contact hole which contacts this electrode for auxiliary capacity, and said pixel electrode.

[Claim 2] The liquid crystal display according to claim 1 characterized by forming the area of said pixel electrode in said contact hole section more greatly than the area of said electrode for auxiliary capacity in contact with this pixel electrode.
[Claim 3] The liquid crystal display according to claim 1 or 2 characterized by forming more greatly than the width of face of said electrode for auxiliary capacity the width of face of said auxiliary capacity wiring in said auxiliary part by volume.
[Claim 4] Said auxiliary capacity wiring is the liquid crystal display of three claim 1 characterized by serving as said address wiring thru/or given in any 1

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term.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the liquid crystal display of a active-matrix mold with respect to a liquid crystal display.
[0002]
[Description of the Prior Art] In order to raise the numerical aperture of the pixel of an array substrate and to raise the light transmittance of a liquid crystal cell in an active matrix liquid crystal display, the structure shown below is taken.
[0003] That is, in order to prepare sufficient auxiliary capacity, without reducing the numerical aperture of a pixel greatly, an island-like electrode is prepared on the same flat surface as data wiring so that it may lap on address wiring, and the TFT array substrate of the structure which contacted the pixel electrode electrically through the contact hole which punctured this island-like electrode to the insulator layer is used. (JP,6-175156,A publication)
[0004]
[Problem(s) to be Solved by the Invention] Moreover, by carrying out the laminating of the coloring layer of two or more colors, a column-like spacer is formed in an opposite substrate side, and keeping the gap between substrates constant with this spacer is performed. Although it was desirable to have arranged this spacer on address wiring in order to raise a numerical aperture, there was a problem that substrate spacing was uncontrollable by the effect of the shape of surface type of an array substrate to homogeneity depending on the arrangement location of a spacer.
[0005] It was made in order to solve these problems, and it has the auxiliary capacity structure where the stable auxiliary capacity value is acquired, and a gap uniform between substrates is obtained by arrangement of a pillar-shaped spacer, and this invention aims at offering the liquid crystal display with which a good

display is attained.
[0006]
[Means for Solving the Problem] The pixel electrode with which address wiring of two or more, data wiring, and a switching element were formed on the insulating substrate, respectively, and the liquid crystal display of this invention was formed in the upper layer of the switching element of a parenthesis through the insulating layer, In the liquid crystal display equipped with the liquid crystal layer pinched between the 1st substrate which has the auxiliary part by volume electrically connected with this pixel electrode, respectively, the 2nd substrate with which the counterelectrode was formed on the insulating substrate, and said 1st substrate and 2nd substrate While forming said auxiliary part by volume with auxiliary capacity wiring by which opposite arrangement was carried out through said data wiring, the electrode for auxiliary capacity formed in this layer, this electrode for auxiliary capacity, and the insulator layer It is characterized by carrying out hold arrangement of the pillar-shaped spacer for maintaining a gap with said 2nd substrate in the contact hole which contacts this electrode for auxiliary capacity, and said pixel electrode.
[0007] In this invention, the pillar-shaped spacer for maintaining the gap of the 1st substrate and the 2nd substrate is projected and formed on an opposite substrate as a layered product of the layer (coloring layer) of two or more usually different colors. And in such a pillar-shaped spacer, the pillar-shaped spacer which has a desired property can be obtained by choosing the order of a laminating of a coloring layer paying attention to the surface roughness of each coloring layer, a degree of hardness, the content of a specific impurity, etc. Moreover, when concentration, such as resin solid content which constitutes a coloring layer, differs, respectively, by changing the thickness (height) and the order of a laminating of each coloring layer, the height of the whole pillar-shaped spacer can be changed freely, and the pillar-shaped spacer which has the stable height can be formed by considering as the still more fixed order of a laminating.
[0008] Moreover, auxiliary capacity wiring can serve as address wiring in this invention. In the liquid crystal display of this invention, although the auxiliary part by volume consists of data wiring, an electrode for auxiliary capacity formed in this layer, and auxiliary capacity wiring, since data wiring and this layer are formed with a metal, its workability is good and etching precision is high, fixed auxiliary capacity value is always acquired with the electrode for auxiliary capacity, and auxiliary capacity wiring, and a good display is usually realized.
[0009] Moreover, since the contact hole which connects electrically such an electrode for auxiliary capacity and a pixel electrode has a flat pars basilaris ossis occipitalis, and there is no level difference and it has sufficient area, in such a

contact hole, it is stabilized, hold arrangement of the pillar-shaped spacer which is gap material can be carried out, and a uniform gap is held between substrates. Therefore, display unevenness is lost and the yield improves.

[0010] In the contact hole section which contacts the electrode for auxiliary capacity, and a pixel electrode in consideration of the doubling precision in a photo etching process in this invention, it is still more desirable to form the area of a pixel electrode more greatly than the area of the electrode for auxiliary capacity. Thus, when area of a pixel electrode is made larger than that of the electrode for auxiliary capacity, with the location precision in these electrode formation, auxiliary capacity value is hardly changed, and good display image quality is acquired, and also arrangement of the pillar-shaped spacer into a contact hole is easy.

[0011] Similarly, in the auxiliary part by volume which consists of the electrode for auxiliary capacity, and lower layer auxiliary capacity wiring in consideration of the doubling precision in a photo etching process, it is desirable to form the width of face of auxiliary capacity wiring more greatly than the width of face of the electrode for auxiliary capacity. When it does in this way, with the location precision in formation of auxiliary capacity wiring and the electrode for auxiliary capacity, auxiliary capacity value is not changed and good display image quality is acquired.

[0012]

[Embodiment of the Invention] Hereafter, the example of this invention is explained respectively with reference to drawing 1 thru/or drawing 4 .

[0013] Drawing 1 shows the equal circuit of the TFT array substrate used for the example of the liquid crystal display of this invention, and drawing 2 shows the outline top view per pixel of this TFT array substrate. Moreover, drawing 3 shows the sectional view of TFT which met the A-A line in drawing 2 , and drawing 4 shows the sectional view of an auxiliary part by volume which similarly met the B-B line in drawing 2 .

[0014] First, the outline of the TFT array substrate used for an example is explained. As shown in drawing 1 , on a transparent insulating substrate 7 like a glass substrate, the address wiring 8 of two or more and the data wiring 9 of two or more cross, and are formed, and TFT10 is formed as a switching element for every [the] pixel of each crossing partition. Moreover, the auxiliary capacity wiring 11 is formed in parallel with the address wiring 8. And in each pixel, the gate electrode 12 of TFT10 is projected and formed in the address wiring 8, and is electrically connected to it, and the drain electrode 13 is projected and formed in the data wiring 9, and is electrically connected to it. Furthermore, connection

formation of the liquid crystal capacity 15 and the auxiliary capacity 16 is carried out at the source electrode 14, respectively.

[0015] Next, the structure of such a TFT array substrate is explained.

[0016] In the TFT array substrate of an example, as shown in drawing 2 and drawing 3 , respectively, the address wiring 8 and the gate electrode 12 which consist of metals, such as aluminum, Mo, W, Ta, and Ti, through the under coat film (illustration is omitted.) which consists of silicon oxide etc. on an insulating substrate 7 are formed in one, and the gate dielectric film 17 with which flattening of the front face which consists of silicon oxide etc. on them was carried out is formed. Moreover, the channel protective layer 20 which consists of the a-Si (amorphous silicon) layer 18, a contact layer 19, CHITSU-ized silicon, etc. is formed in order on the upper gate dielectric film 17 of the gate electrode 12 through the insulator layer (illustration is omitted.) which consists of CHITSU-ized silicon etc., it connects with the contact layer 19 and the drain electrode 13 and the data wiring 9 are formed. Furthermore, the insulator layer (interlayer insulation film) 22 by which oxide skin 13a was prepared in the front face of the drain electrode 13, and flattening of the front face was carried out on them, and the contact hole 21 was formed in the position is formed. Furthermore, the pixel electrode 23 which consists of transparent materials, such as indium Tin oxide (ITO), is formed on this interlayer insulation film 22, the source electrode 14 is further formed in the contact hole 21 section, and the pixel electrode 23 and the contact layer 19 are electrically connected by this source electrode 14.

[0017] Moreover, in such an auxiliary part by volume of a TFT array substrate, as shown in drawing 4 , on the address wiring 8, the data wiring 9 and the electrode 24 for auxiliary capacity formed in this layer are arranged through gate dielectric film 17, and auxiliary capacity is formed with this electrode 24 for auxiliary capacity, and the lower layer address wiring 8. Moreover, the contact hole 25 is formed in the interlayer insulation film 22 of such the auxiliary capacity 16 section, and the pixel electrode 23 and the electrode 24 for auxiliary capacity which were formed on the interlayer insulation film 22 are electrically connected to it in this contact hole 25 section.

[0018] Furthermore, in such a contact hole 25, hold arrangement of the column-like spacer 26 is carried out, and the point is contacted by the pixel electrode 23 of the contact hole 25 section. That is, opposite arrangement of the opposite substrate 28 which has the pillar-shaped spacer 26 which the color filter 27 was formed on the insulating substrate 7, and was formed of the laminating of a coloring layer with it, and the above mentioned TFT array substrate is carried out, and hold arrangement of the point of the pillar-shaped spacer 26 is carried

out in the liquid crystal display which made a liquid crystal constituent 29 like TN liquid crystal intervene between substrates into the contact hole 25 of the auxiliary part by volume of a TFT array substrate. Moreover, in such the contact hole 25 section, the area of the pixel electrode 23 is formed more greatly than the area of the lower layer electrode 24 for auxiliary capacity, and the width of face of the address wiring 8 of further a lower layer is formed more greatly than the width of face of the electrode 24 for auxiliary capacity.

[0019] Thus, in the liquid crystal display of the example constituted, the electrode 24 for auxiliary capacity is formed with the metal in the data wiring 9 and this layer, since workability is good and etching precision is high, a fixed value is always acquired as an auxiliary capacity which consists of such an electrode 24 for auxiliary capacity, and the address wiring 8, and a good display is realized.

[0020] Moreover, since a pars basilaris ossis occipitalis is flat, there is no level difference and the contact hole 25 which contacts such an electrode 24 for auxiliary capacity and the pixel electrode 23 has sufficient area of base, it is easy, and it can be stabilized, and arrangement of the pillar-shaped spacer 26 into such a contact hole 25 can carry out hold arrangement, and can obtain a uniform gap between substrates. Therefore, display unevenness is lost and the yield improves.

[0021] Furthermore, in the contact hole 25 section, since the area of the pixel electrode 23 is larger than the area of the electrode 24 for auxiliary capacity, it is rare to change the value of auxiliary capacity by the location gap in these electrode formation, and good display image quality is acquired. Moreover, since the width of face of the lower layer address wiring 8 is larger than the width of face of the electrode 24 for auxiliary capacity, auxiliary capacity value is hardly changed by these location gaps, and good display image quality is acquired.

[0022] Furthermore, since the pixel electrode 23 is formed on the upper interlayer insulation film 22 rather than the address wiring 8 and the data wiring 9, the address wiring 8 and the data wiring 9 function as a protection-from-light layer which is a pixel, respectively, and the numerical aperture of a pixel improves. Moreover, in the contact hole 21 of the TFT section, since the source electrode 14 is formed so that the pixel electrode 23 and the contact layer 19 of TFT may be connected, and this source electrode 14 serves as a protection-from-light layer to TFT, the image quality fall by optical leak of TFT can be prevented.

[0023] Next, the concrete example of this invention is indicated.

[0024]

[Example] First, as it was shown below, the TFT array substrate was manufactured.

[0025] That is, it is an insulating substrate 7. It aims at protection of a substrate and the pollution control from a substrate on the glass substrate (#7059 by U.S.

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Corning, Inc.) of 1.1mm thickness. silicon oxide -- the sputtering method or plasma CVD (chemical vapor deposition) -- by law etc. Abbreviation After making the thickness of 300nm deposit and forming the under coat film, On this under coat film, it is abbreviation about aluminum by the sputtering method. It is made to deposit on 200nm thickness. Subsequently, some patterns of the address wiring 8 and the gate electrode 12 **** auxiliary capacity wiring 11 were formed with photolithography, and it was etched using the mixed acid of a phosphoric acid, a nitric acid, and an acetic acid. Subsequently, it is abbreviation by the sputtering method about Mo-Ta. It was made to deposit on 300nm thickness, and the remaining part of the pattern of the address wiring 8 **** auxiliary capacity wiring 11 was etched so that the taper of 30 or less degrees might be formed in an edge part to the 7th page of a glass substrate by the plasma chemical dry etching method of the mixed gas of carbon tetrafluoride + oxygen. The etching conditions at this time are the flow rate of carbon tetrafluoride. 160sccm, flow rate of oxygen It was 30Pa in 320sccm and etching pressure. In this way, the pattern of the address wiring 8 and the auxiliary capacity wiring 11 was completed.

[0026] Next, after making silicon oxide deposit so that a front face may carry out flattening by the plasma-CVD method for example, by tetraethyl oxy-silane gas, flattening of it was further carried out by the etching method or polish, and gate dielectric film 17 was formed. In addition, the fall of stage pieces, such as the data wiring 9 formed on gate dielectric film 17 at a back process, or a coverage can be prevented by carrying out flattening of the front face of gate dielectric film 17 in this way. Then, after making three layers, the insulator layer and the a-Si layer 18 which consist of CHITSU-ized silicon, and the channel protective layer 20 which consists of CHITSU-ized silicon, deposit continuously with a CVD method, patterning of the upper channel protective layer 20 was carried out. Subsequently, after performing the ion implantation which used phosphine gas (PH3 gas) for the contact parts of the source electrode of the both sides of the a-Si layer 18, and a drain electrode and forming the contact layer 19 formed into low resistance, patterning of the a-Si layer 18 was carried out.

[0027] Next, aluminum film was formed by the sputtering method, patterning was carried out, and the data wiring 9, the drain electrode 13, and data wiring and the electrode 24 for auxiliary capacity of this layer were formed, respectively. In addition, after forming the drain electrode 13 on one contact layer 19, it raised layer insulation nature with the pixel electrode 23 which forms oxide skin 13a in a front face by anodizing, and is formed at a back process.

[0028] Subsequently, the interlayer insulation film 22 which consists of CHITSU-ized silicon was formed by the plasma-CVD method. In addition, at this time, CHITSU-ized silicon is made to divide and deposit on two-layer, and it is

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desirable after deposition of a CHITSU-ized silicon layer of the 1st layer to carry out flattening of the front face by the etchback method or polish processing. By performing such processing, flattening of the front face of the interlayer insulation film 22 finally formed is carried out, and it can prevent the fall of the stage piece of the pixel electrode 23 or the source electrode 14 formed on it at a back process, or a coverage.

[0029] Next, on the interlayer insulation film 22 with which flattening of the front face formed in this way was carried out, after forming the ITO film, patterning was carried out and the pixel electrode 23 was formed. At this time, in the upper layer of the electrode 24 for auxiliary capacity, the contact hole 25 was formed in the interlayer insulation film 22, it connected [interlayer insulation film] also in this hole, and the pixel electrode 23 was formed. In addition, it sets in the contact section formed in this way, and is 20-30 micrometers about the path of a pars basilaris ossis occipitalis. It is 10-15 micrometers about the thickness of the pixel electrode 23. It carries out and the path of the contact surface (inferior surface of tongue) of the pixel electrode 23 is at one side from the path of the contact surface (top face) of the lower layer electrode 24 for auxiliary capacity. 1.5 to 4 micrometer It was made to become large.

[0030] Subsequently, after forming opening (contact hole 21 which contacts the pixel electrode 23 and the contact layer 19) of the pad section of address wiring with reactive ion etching (RIE) and HF system etching reagent, after forming three layers of Mo-aluminum-Mo by the sputtering method, patterning was carried out, the source electrode 14 was formed, and the pixel electrode 23 and the contact layer 19 of TFT were electrically connected with this source electrode 24.

[0031] Next, it is an orientation film ingredient to the whole surface of the TFT array substrate obtained in this way. AL-1051 (Japan Synthetic Rubber Co., Ltd. make) was applied to the thickness of 50nm, rubbing processing was performed, and the orientation film was formed.

[0032] Also to an opposite substrate side, subsequently, on the glass substrate (#7059 by Corning, Inc.) of 1.1mm thickness The photoresist which made the photo-curing mold acrylic resin in which alkali development is possible distribute carbon black (black pigment) is applied with a spin coat method. the photo mask of the predetermined pattern configuration after drying for 10 minutes at 90 degrees C -- using -- 300 mj/cm2 it exposes with the quantity of light and, subsequently negatives are developed with the alkali water solution of pH11.5 -- 200 degree C BEKU for 1 hour Thickness which has a grid-like pattern 2.0 micrometers The protection-from-light layer (black matrix) was formed. In addition, as a protection-from-light layer, it is also possible to use the film of

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metal systems, such as Cr, CrO/Cr, and CrO/Cr/CrO.

[0033] subsequently, it is the coloring photoresist in which alkali development is possible on the glass substrate with which such a protection-from-light layer was formed after applying CB-2000 (trade name of Fuji hunt technology incorporated company) with a spin coat method and prebaking it, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- 2.2 micrometers of thickness The blue coloring layer was formed. At this time, a blue coloring layer is formed also in the position on a protection-from-light layer, and it is the diameter of 20 micrometers. Blue SUPE 1 SA was formed.

[0034] next, it is the coloring photoresist in which alkali development is possible on the glass substrate with which the blue coloring layer was formed in this way after applying CG-2000 (trade name of Fuji hunt technology incorporated company) with a spin coat method and prebaking it, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- 1.8 micrometers of thickness The green stain layer was formed. At this time, the laminating of the green stain layer is carried out also on blue SUPE 1 SA formed previously, and it is the diameter of 20 micrometers. Blue-green laminating SUPE 1 SA was formed.

[0035] Furthermore, on the glass substrate with which the blue and green coloring layer was formed in this way It is the coloring resist of marketing in which alkali development is possible. CR-2000 (trade name of Fuji hunt technology incorporated company) is applied with a spin coat method. after prebaking, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- thickness 1.3 micrometers The red coloring layer was formed. Diameter of 20 micrometers to which the laminating of the red coloring layer was carried out also on blue-green laminating SUPE 1 SA formed previously at this time, and the laminating of the coloring layer of three colors of blue-green-red was carried out Height Three to 5 micrometer Pillar-shaped SUPE 1 SA was formed. After forming the common electrode which consists of ITO by the sputtering method on the color filter which consists of each coloring layer of blue, green, and red and forming the orientation film which consists of polyimide further after an appropriate time, orientation processing was performed by rubbing and the opposite substrate which has a color filter and a pillar-shaped spacer was obtained.

[0036] And after carrying out opposite arrangement and sticking the obtained opposite substrate and the above mentioned TFT array substrate with adhesives,

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TN liquid crystal constituent was poured in from the inlet with the conventional method, and the liquid crystal display was obtained by subsequently closing an inlet with ultraviolet-rays hardening resin.

[0037] In this way, in the obtained liquid crystal display, the numerical aperture of a pixel was high brightness highly, there is no display unevenness and the display of good image quality was attained.

[0038]

[Effect of the Invention] Since the auxiliary part by volume is formed in the liquid crystal display of this invention with the electrode for auxiliary capacity and address wiring which countered on both sides of the insulator layer, and the electrodes for auxiliary capacity are data wiring and this layer, it is formed with a metal, workability is good and etching precision is high so that clearly from the above explanation, fixed auxiliary capacity value is always acquired and good display image quality is attained. Moreover, in the contact hole which contacts such an electrode for auxiliary capacity, and a pixel electrode and which there is no level difference and has sufficient area, since hold arrangement of the pillar-shaped spacer which is gap material is carried out, a gap uniform between substrates is held and the good display without display unevenness is obtained.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the liquid crystal display of a active-matrix mold with respect to a liquid crystal display.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] In order to raise the numerical aperture of the pixel of an array substrate and to raise the light transmittance of a liquid crystal cell in an active matrix liquid crystal display, the structure shown below is taken.
[0003] That is, in order to prepare sufficient auxiliary capacity, without reducing the numerical aperture of a pixel greatly, an island-like electrode is prepared on the same flat surface as data wiring so that it may lap on address wiring, and the TFT array substrate of the structure which contacted the pixel electrode electrically through the contact hole which punctured this island-like electrode to the insulator layer is used. (JP,6-175156,A publication)

[Translation done.]

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* NOTICES *

EFFECT OF THE INVENTION

[Effect of the Invention] Since the auxiliary part by volume is formed in the liquid crystal display of this invention with the electrode for auxiliary capacity and address wiring which countered on both sides of the insulator layer, and the electrodes for auxiliary capacity are data wiring and this layer, it is formed with a metal, workability is good and etching precision is high so that clearly from the above explanation, fixed auxiliary capacity value is always acquired and good display image quality is attained. Moreover, in the contact hole which contacts such an electrode for auxiliary capacity, and a pixel electrode and which there is no level difference and has sufficient area, since hold arrangement of the pillar-shaped spacer which is gap material is carried out, a gap uniform between substrates is held and the good display without display unevenness is obtained.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Moreover, by carrying out the laminating of the coloring layer of two or more colors, a column-like spacer is formed in an opposite substrate side, and keeping the gap between substrates constant with this spacer is performed. Although it was desirable to have arranged this spacer on address wiring in order to raise a numerical aperture, there was a problem that substrate spacing was uncontrollable by the effect of the shape of surface type of an array substrate to homogeneity depending on the arrangement location of a spacer.
[0005] It was made in order to solve these problems, and it has the auxiliary capacity structure where the stable auxiliary capacity value is acquired, and a gap uniform between substrates is obtained by arrangement of a pillar-shaped spacer, and this invention aims at offering the liquid crystal display with which a good display is attained.

[Translation done.]

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* NOTICES *

MEANS

[Means for Solving the Problem] The pixel electrode with which address wiring of two or more, data wiring, and a switching element were formed on the insulating substrate, respectively, and the liquid crystal display of this invention was formed in the upper layer of the switching element of a parenthesis through the insulating layer, In the liquid crystal display equipped with the liquid crystal layer pinched between the 1st substrate which has the auxiliary part by volume electrically connected with this pixel electrode, respectively, the 2nd substrate with which the counterelectrode was formed on the insulating substrate, and said 1st substrate and 2nd substrate While forming said auxiliary part by volume with auxiliary capacity wiring by which opposite arrangement was carried out through said data wiring, the electrode for auxiliary capacity formed in this layer, this electrode for auxiliary capacity, and the insulator layer It is characterized by carrying out hold arrangement of the pillar-shaped spacer for maintaining a gap with said 2nd substrate in the contact hole which contacts this electrode for auxiliary capacity, and said pixel electrode.
[0007] In this invention, the pillar-shaped spacer for maintaining the gap of the 1st substrate and the 2nd substrate is projected and formed on an opposite substrate as a layered product of the layer (coloring layer) of two or more usually different colors. And in such a pillar-shaped spacer, the pillar-shaped spacer which has a desired property can be obtained by choosing the order of a laminating of a coloring layer paying attention to the surface roughness of each coloring layer, a degree of hardness, the content of a specific impurity, etc. Moreover, when concentration, such as resin solid content which constitutes a coloring layer, differs, respectively, by changing the thickness (height) and the order of a laminating of each coloring layer, the height of the whole pillar-shaped spacer can be changed freely, and the pillar-shaped spacer which has the stable height can be formed by considering as the still more fixed order of a laminating.

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[0008] Moreover, auxiliary capacity wiring can serve as address wiring in this invention. In the liquid crystal display of this invention, although the auxiliary part by volume consists of data wiring, an electrode for auxiliary capacity formed in this layer, and auxiliary capacity wiring, since data wiring and this layer are formed with a metal, its workability is good and etching precision is high, fixed auxiliary capacity value is always acquired with the electrode for auxiliary capacity, and auxiliary capacity wiring, and a good display is usually realized.
[0009] Moreover, since the contact hole which connects electrically such an electrode for auxiliary capacity and a pixel electrode has a flat pars basilaris ossis occipitalis, and there is no level difference and it has sufficient area, in such a contact hole, it is stabilized, hold arrangement of the pillar-shaped spacer which is gap material can be carried out, and a uniform gap is held between substrates. Therefore, display unevenness is lost and the yield improves.
[0010] In the contact hole section which contacts the electrode for auxiliary capacity, and a pixel electrode in consideration of the doubling precision in a photo etching process in this invention, it is still more desirable to form the area of a pixel electrode more greatly than the area of the electrode for auxiliary capacity. Thus, when area of a pixel electrode is made larger than that of the electrode for auxiliary capacity, with the location precision in these electrode formation, auxiliary capacity value is hardly changed, and good display image quality is acquired, and also arrangement of the pillar-shaped spacer into a contact hole is easy.
[0011] Similarly, in the auxiliary part by volume which consists of the electrode for auxiliary capacity, and lower layer auxiliary capacity wiring in consideration of the doubling precision in a photo etching process, it is desirable to form the width of face of auxiliary capacity wiring more greatly than the width of face of the electrode for auxiliary capacity. When it does in this way, with the location precision in formation of auxiliary capacity wiring and the electrode for auxiliary capacity, auxiliary capacity value is not changed and good display image quality is acquired.
[0012]
[Embodiment of the Invention] Hereafter, the example of this invention is explained respectively with reference to drawing 1 thru/or drawing 4 .
[0013] Drawing 1 shows the equal circuit of the TFT array substrate used for the example of the liquid crystal display of this invention, and drawing 2 shows the outline top view per pixel of this TFT array substrate. Moreover, drawing 3 shows the sectional view of TFT which met the A-A line in drawing 2 , and drawing 4 shows the sectional view of an auxiliary part by volume which

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similarly met the B-B line in drawing 2 .

[0014] First, the outline of the TFT array substrate used for an example is explained. As shown in drawing 1 , on a transparent insulating substrate 7 like a glass substrate, the address wiring 8 of two or more and the data wiring 9 of two or more cross, and are formed, and TFT10 is formed as a switching element for every [the] pixel of each crossing partition. Moreover, the auxiliary capacity wiring 11 is formed in parallel with the address wiring 8. And in each pixel, the gate electrode 12 of TFT10 is projected and formed in the address wiring 8, and is electrically connected to it, and the drain electrode 13 is projected and formed in the data wiring 9, and is electrically connected to it. Furthermore, connection formation of the liquid crystal capacity 15 and the auxiliary capacity 16 is carried out at the source electrode 14, respectively.

[0015] Next, the structure of such a TFT array substrate is explained.

[0016] In the TFT array substrate of an example, as shown in drawing 2 and drawing 3 , respectively, the address wiring 8 and the gate electrode 12 which consist of metals, such as aluminum, Mo, W, Ta, and Ti, through the under coat film (illustration is omitted.) which consists of silicon oxide etc. on an insulating substrate 7 are formed in one, and the gate dielectric film 17 with which flattening of the front face which consists of silicon oxide etc. on them was carried out is formed. Moreover, the channel protective layer 20 which consists of the a-Si (amorphous silicon) layer 18, a contact layer 19, CHITSU-ized silicon, etc. is formed in order on the upper gate dielectric film 17 of the gate electrode 12 through the insulator layer (illustration is omitted.) which consists of CHITSU-ized silicon etc., it connects with the contact layer 19 and the drain electrode 13 and the data wiring 9 are formed. Furthermore, the insulator layer (interlayer insulation film) 22 by which oxide skin 13a was prepared in the front face of the drain electrode 13, and flattening of the front face was carried out on them, and the contact hole 21 was formed in the position is formed. Furthermore, the pixel electrode 23 which consists of transparent materials, such as indium Tin oxide (ITO), is formed on this interlayer insulation film 22, the source electrode 14 is further formed in the contact hole 21 section, and the pixel electrode 23 and the contact layer 19 are electrically connected by this source electrode 14.

[0017] Moreover, in such an auxiliary part by volume of a TFT array substrate, as shown in drawing 4 , on the address wiring 8, the data wiring 9 and the electrode 24 for auxiliary capacity formed in this layer are arranged through gate dielectric film 17, and auxiliary capacity is formed with this electrode 24 for auxiliary capacity, and the lower layer address wiring 8. Moreover, the contact hole 25 is formed in the interlayer insulation film 22 of such the auxiliary capacity 16

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section, and the pixel electrode 23 and the electrode 24 for auxiliary capacity which were formed on the interlayer insulation film 22 are electrically connected to it in this contact hole 25 section.

[0018] Furthermore, in such a contact hole 25, hold arrangement of the column-like spacer 26 is carried out, and the point is contacted by the pixel electrode 23 of the contact hole 25 section. That is, opposite arrangement of the opposite substrate 28 which has the pillar-shaped spacer 26 which the color filter 27 was formed on the insulating substrate 7, and was formed of the laminating of a coloring layer with it, and the above mentioned TFT array substrate is carried out, and hold arrangement of the point of the pillar-shaped spacer 26 is carried out in the liquid crystal display which made a liquid crystal constituent 29 like TN liquid crystal intervene between substrates into the contact hole 25 of the auxiliary part by volume of a TFT array substrate. Moreover, in such the contact hole 25 section, the area of the pixel electrode 23 is formed more greatly than the area of the lower layer electrode 24 for auxiliary capacity, and the width of face of the address wiring 8 of further a lower layer is formed more greatly than the width of face of the electrode 24 for auxiliary capacity.

[0019] Thus, in the liquid crystal display of the example constituted, the electrode 24 for auxiliary capacity is formed with the metal in the data wiring 9 and this layer, since workability is good and etching precision is high, a fixed value is always acquired as an auxiliary capacity which consists of such an electrode 24 for auxiliary capacity, and the address wiring 8, and a good display is realized.

[0020] Moreover, since a pars basilaris ossis occipitalis is flat, there is no level difference and the contact hole 25 which contacts such an electrode 24 for auxiliary capacity and the pixel electrode 23 has sufficient area of base, it is easy, and it can be stabilized, and arrangement of the pillar-shaped spacer 26 into such a contact hole 25 can carry out hold arrangement, and can obtain a uniform gap between substrates. Therefore, display unevenness is lost and the yield improves.

[0021] Furthermore, in the contact hole 25 section, since the area of the pixel electrode 23 is larger than the area of the electrode 24 for auxiliary capacity, it is rare to change the value of auxiliary capacity by the location gap in these electrode formation, and good display image quality is acquired. Moreover, since the width of face of the lower layer address wiring 8 is larger than the width of face of the electrode 24 for auxiliary capacity, auxiliary capacity value is hardly changed by these location gaps, and good display image quality is acquired.

[0022] Furthermore, since the pixel electrode 23 is formed on the upper interlayer insulation film 22 rather than the address wiring 8 and the data wiring 9, the address wiring 8 and the data wiring 9 function as a protection-from-light layer which is a pixel, respectively, and the numerical aperture of a pixel improves.

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Moreover, in the contact hole 21 of the TFT section, since the source electrode 14 is formed so that the pixel electrode 23 and the contact layer 19 of TFT may be connected, and this source electrode 14 serves as a protection-from-light layer to TFT, the image quality fall by optical leak of TFT can be prevented.
[0023] Next, the concrete example of this invention is indicated.

[Translation done.]

* NOTICES *

EXAMPLE

[Example] First, as it was shown below, the TFT array substrate was manufactured.
[0025] That is, it is an insulating substrate 7. It aims at protection of a substrate and the pollution control from a substrate on the glass substrate (#7059 by U.S. Corning, Inc.) of 1.1mm thickness, silicon oxide -- the sputtering method or plasma CVD (chemical vapor deposition) -- by law etc. Abbreviation After making the thickness of 300nm deposit and forming the under coat film, On this under coat film, it is abbreviation about aluminum by the sputtering method. It is made to deposit on 200nm thickness. Subsequently, some patterns of the address wiring 8 and the gate electrode 12 **** auxiliary capacity wiring 11 were formed with photolithography, and it was etched using the mixed acid of a phosphoric acid, a nitric acid, and an acetic acid. Subsequently, it is abbreviation by the sputtering method about Mo-Ta. It was made to deposit on 300nm thickness, and the remaining part of the pattern of the address wiring 8 **** auxiliary capacity wiring 11 was etched so that the taper of 30 or less degrees might be formed in an edge part to the 7th page of a glass substrate by the plasma chemical dry etching method of the mixed gas of carbon tetrafluoride + oxygen. The etching conditions at this time are the flow rate of carbon tetrafluoride. 160sccm, flow rate of oxygen It was 30Pa in 320sccm and etching pressure. In this way, the pattern of the address wiring 8 and the auxiliary capacity wiring 11 was completed.
[0026] Next, after making silicon oxide deposit so that a front face may carry out flattening by the plasma-CVD method for example, by tetraethyl oxy-silane gas, flattening of it was further carried out by the etching method or polish, and gate dielectric film 17 was formed. In addition, the fall of stage pieces, such as the data wiring 9 formed on gate dielectric film 17 at a back process, or a coverage can be prevented by carrying out flattening of the front face of gate dielectric film 17 in this way. Then, after making three layers, the insulator layer and the a-Si

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layer 18 which consist of CHITSU-ized silicon, and the channel protective layer 20 which consists of CHITSU-ized silicon, deposit continuously with a CVD method, patterning of the upper channel protective layer 20 was carried out. Subsequently, after performing the ion implantation which used phosphine gas (PH3 gas) for the contact parts of the source electrode of the both sides of the a-Si layer 18, and a drain electrode and forming the contact layer 19 formed into low resistance, patterning of the a-Si layer 18 was carried out.

[0027] Next, aluminum film was formed by the sputtering method, patterning was carried out, and the data wiring 9, the drain electrode 13, and data wiring and the electrode 24 for auxiliary capacity of this layer were formed, respectively. In addition, after forming the drain electrode 13 on one contact layer 19, it raised layer insulation nature with the pixel electrode 23 which forms oxide skin 13a in a front face by anodizing, and is formed at a back process.

[0028] Subsequently, the interlayer insulation film 22 which consists of CHITSU-ized silicon was formed by the plasma-CVD method. In addition, at this time, CHITSU-ized silicon is made to divide and deposit on two-layer, and it is desirable after deposition of a CHITSU-ized silicon layer of the 1st layer to carry out flattening of the front face by the etchback method or polish processing. By performing such processing, flattening of the front face of the interlayer insulation film 22 finally formed is carried out, and it can prevent the fall of the stage piece of the pixel electrode 23 or the source electrode 14 formed on it at a back process, or a coverage.

[0029] Next, on the interlayer insulation film 22 with which flattening of the front face formed in this way was carried out, after forming the ITO film, patterning was carried out and the pixel electrode 23 was formed. At this time, in the upper layer of the electrode 24 for auxiliary capacity, the contact hole 25 was formed in the interlayer insulation film 22, it connected [interlayer insulation film] also in this hole, and the pixel electrode 23 was formed. In addition, it sets in the contact section formed in this way, and is 20-30 micrometers about the path of a pars basilaris ossis occipitalis. It is 10-15 micrometers about the thickness of the pixel electrode 23. It carries out and the path of the contact surface (inferior surface of tongue) of the pixel electrode 23 is at one side from the path of the contact surface (top face) of the lower layer electrode 24 for auxiliary capacity. 1.5 to 4 micrometer It was made to become large.

[0030] Subsequently, after forming opening (contact hole 21 which contacts the pixel electrode 23 and the contact layer 19) of the pad section of address wiring with reactive ion etching (RIE) and HF system etching reagent, after forming three layers of Mo-aluminum-Mo by the sputtering method, patterning was carried out, the source electrode 14 was formed, and the pixel electrode 23 and

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the contact layer 19 of TFT were electrically connected with this source electrode 24.

[0031] Next, it is an orientation film ingredient to the whole surface of the TFT array substrate obtained in this way. AL-1051 (Japan Synthetic Rubber Co., Ltd. make) was applied to the thickness of 50nm, rubbing processing was performed, and the orientation film was formed.

[0032] Subsequently, it is a spin coat method about the photoresist which made the photo-curing mold acrylic resin in which alkali development is possible distribute carbon black (black pigment) also to an opposite substrate side on the glass substrate (#7059 by Corning, Inc.) of 1.1mm thickness. the photo mask of the predetermined pattern configuration after applying and drying for 10 minutes at 90 degrees C -- using -- 300 mj/cm2 it exposes with the quantity of light and, subsequently negatives are developed with the alkali water solution of pH11.5 -- 200 degree C Thickness which for 1 hour and has a grid-like pattern 2.0 micrometers The protection-from-light layer (black matrix) was formed. In addition, as a protection-from-light layer, it is also possible to use the film of metal systems, such as Cr, CrO/Cr, and CrO/Cr/CrO.

[0033] subsequently, it is the coloring photoresist in which alkali development is possible on the glass substrate with which such a protection-from-light layer was formed after applying CB-2000 (trade name of Fuji hunt technology incorporated company) with a spin coat method and prebaking it, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- 2.2 micrometers of thickness The blue coloring layer was formed. At this time, a blue coloring layer is formed also in the position on a protection-from-light layer, and it is the diameter of 20 micrometers. Blue SUPE 1 SA was formed.

[0034] next, it is the coloring photoresist in which alkali development is possible on the glass substrate with which the blue coloring layer was formed in this way after applying CG-2000 (trade name of Fuji hunt technology incorporated company) with a spin coat method and prebaking it, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- 1.8 micrometers of thickness The green stain layer was formed. At this time, the laminating of the green stain layer is carried out also on blue SUPE 1 SA formed previously, and it is the diameter of 20 micrometers. Blue-green laminating SUPE 1 SA was formed.

[0035] Furthermore, it is the coloring resist of marketing in which alkali development is possible on the glass substrate with which the blue and green coloring layer was formed in this way. It is a spin coat method about CR-2000

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(trade name of Fuji hunt technology incorporated company). after applying and prebaking, it exposes with the predetermined quantity of light (100 mj/cm2), and, subsequently negatives are developed with the developer of pH11.5 -- 200 degree C 1 hour -- BEKU -- thickness 1.3 micrometers The red coloring layer was formed. Diameter of 20 micrometers to which the laminating of the red coloring layer was carried out also on blue-green laminating SUPE 1 SA formed previously at this time, and the laminating of the coloring layer of three colors of blue-green-red was carried out Height Three to 5 micrometer Pillar-shaped SUPE 1 SA was formed. After forming the common electrode which consists of ITO by the sputtering method on the color filter which consists of each coloring layer of blue, green, and red and forming the orientation film which consists of polyimide further after an appropriate time, orientation processing was performed by rubbing and the opposite substrate which has a color filter and a pillar-shaped spacer was obtained.

[0036] And after carrying out opposite arrangement and sticking the obtained opposite substrate and the above mentioned TFT array substrate with adhesives, TN liquid crystal constituent was poured in from the inlet with the conventional method, and the liquid crystal display was obtained by subsequently closing an inlet with ultraviolet-rays hardening resin.

[0037] In this way, in the obtained liquid crystal display, the numerical aperture of a pixel was high brightness highly, there is no display unevenness and the display of good image quality was attained.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

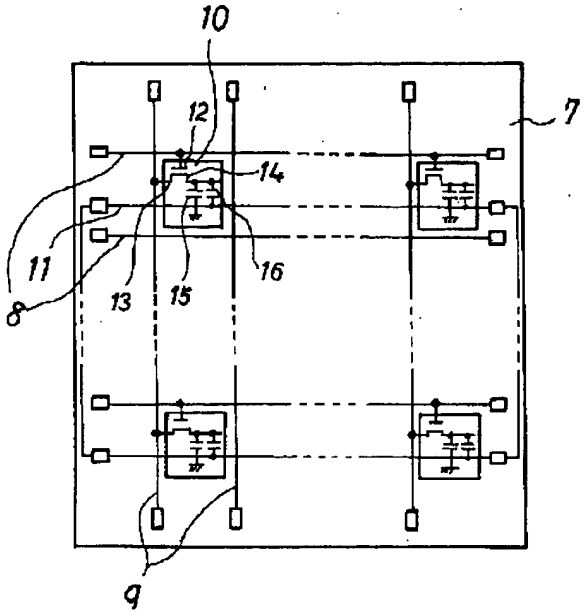
[Brief Description of the Drawings]
[Drawing 1] The representative circuit schematic of the TFT array substrate used for the example of the liquid crystal display of this invention.
[Drawing 2] The outline top view per pixel of the TFT array substrate used for this example.
[Drawing 3] The sectional view of TFT which met the A-A line in the TFT array substrate of drawing 2 .
[Drawing 4] The sectional view of an auxiliary part by volume which met the B-B line in the TFT array substrate of drawing 2 .
[Description of Notations]
7 ..... Insulating substrate
8 ..... Address wiring
9 ..... Data wiring
11 ..... Auxiliary capacity wiring
12 ..... Gate electrode
13 ..... Drain electrode
14 ..... Source electrode
17 ..... Gate dielectric film
18 ..... a-Si layer
19 ..... Contact layer
21 25 ..... Contact hole
22 ..... Interlayer insulation film
23 ..... Pixel electrode
24 ..... Electrode for auxiliary capacity
26 ..... Pillar-shaped spacer

[Translation done.]

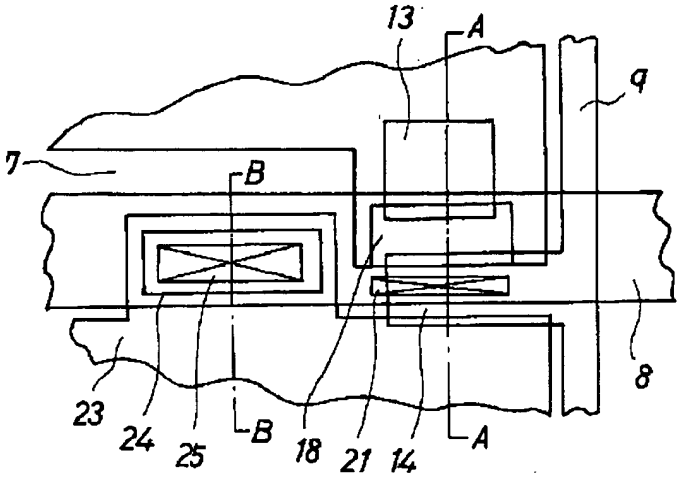
* NOTICES *

DRAWINGS

[Drawing 1]



[Drawing 2]



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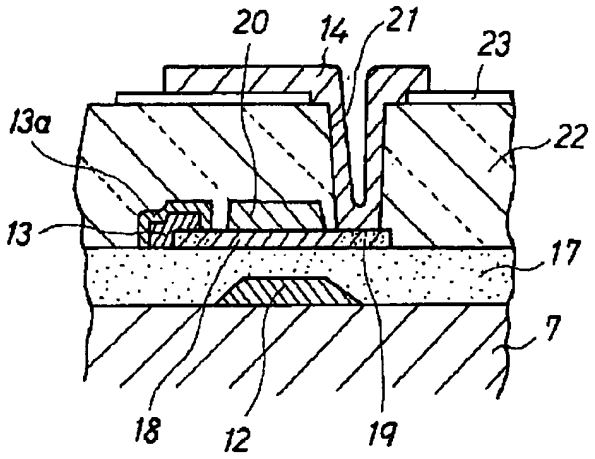
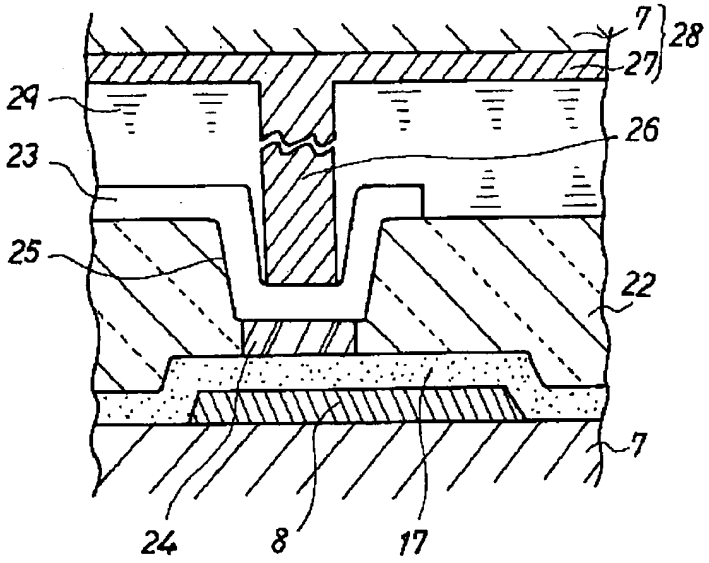
[Drawing 3]



[Drawing 4]



[Translation done.]